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Abstract

An inoculant (Sila-bac) and a non-protein nitrogen (LSA-100) silage additive were evaluated with whole-plant, forage sorghum silage. Sila-bac silage had the fastest temperature rise and peaked at 10 C above its initial temperature. LSA-100 silage had a slow, steady temperature rise and reached a maximum of 22 C above its initial. Control silage peaked at 15 C above its initial. Steers fed LSA-100 silage gained 7 to 9% faster than did those fed control or Sila-bac silages. LSA-100 silage was consumed in greatest amount; Sila-bac silage, in the least. The two additives improved feed efficiency by 3% over the control. Both additives improved aerobic stability; control silage heated after 3 days; Sila-bac and LSA-100 after 7. Dry matter recovery from the stave silos was similar for control (78.1%) and LSA-100 silages (77.3%), but higher for Sila-bac silage (81.2%). When fermentation, storage, and feedout losses were combined with steer performance, pounds of gain per ton of ensiled forage were 88.8 for Sila-bac, 84.5 for LSA-100, and 82.6 for control silages.

Keywords

Cattlemen's Day, 1982; Report of progress (Kansas State University. Agricultural Experiment Station); 413; Beef; Sorghum silage; Feed efficiency; Aerobic stability; Dry matter

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Inoculant and Urea-molasses additives for Forage Sorghum Silage[1,2,3]

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Summary

An inoculant (Sila-bac) and a non-protein nitrogen (LSA-100) silage additive were evaluated with whole-plant, forage sorghum silage. Sila-bac silage had the fastest temperature rise and peaked at 10 C above its initial temperature. LSA-100 silage had a slow, steady temperature rise and reached a maximum of 22 C above its initial. Control silage peaked at 15 C above its initial. Steers fed LSA-100 silage gained 7 to 9% faster than did those fed control or Sila-bac silages. LSA-100 silage was consumed in greatest amount; Sila-bac silage, in the least. The two additives improved feed efficiency by 3% over the control.

Both additives improved aerobic stability; control silage heated after 3 days; Sila-bac and LSA-100 after 7. Dry matter recovery from the stave silos was similar for control (78.1%) and LSA-100 silages (77.3%), but higher for Sila-bac silage (81.2%). When fermentation, storage, and feedout losses were combined with steer performance, pounds of gain per ton of ensiled forage were 88.8 for Sila-bac, 84.5 for LSA-100, and 82.6 for control silages.

Introduction

In Kansas, forage sorghum silage is commonly the main component in cattle growing rations. Previous research (Hays and Manhattan) has shown that non-protein nitrogen (NPN) applied to corn and forage sorghum at ensiling will produce silages of variable feeding value. Commercial silage inoculants generally have improved silage dry matter recovery; however, feeding value of the silages has been less consistant.

This trial continued our evaluation of NPN and inoculants for forage sorghum silage.

Experimental Procedure

Forage sorghum silages were made at the Hays Branch Experiment Station in October of 1980, using Asgrow's Titan E hybrid direct-cut at

[1] Research was conducted jointly at the Hays Branch Experiment Station, Hays, and at Kansas State University, Manhattan.

[2] Inoculant (Sila-bac[R]) was provided by Pioneer Hi-Bred International, Inc., Microbial Genetics Division, Portland, Oregon.

[3] Urea-Molasses (LSA-100[R]) was provided by Namolco, Inc., Willow Grove, PA.

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the hard-dough stage (29 to 32% dry matter). Treatments were: 1) control (no additive); 2) Sila-bac applied at 1.0 lb/ton of fresh crop; and 3) LSA-100 applied at 34.5 lb/ton of fresh crop. Additives were applied by hand at the silo blower, and silages were made in concrete stave silos (10 ft x 30 ft). Control silage was made during the morning of October 2; Sila-bac silage, during the afternoon; and LSA-100, during the morning of October 3.

Dry matter losses during fermentation, storage, and feedout were measured by accurately weighing and sampling all loads of fresh crop ensiled and later weighing and sampling all silage removed from the silos. Ensiling temperatures were monitored for the first 7 weeks.

About 450 lb of fresh crop was removed from each silo during filling. For each silage treatment, 12 plastic containers (5-gallon capacity) and six nylon bags (5-gallon capacity) were tightly filled with forage sorghum. The containers were made air tight with lids fitted with rubber O-ring seals and Bunson valves, then transported immediately to Manhattan and stored in a room at 20 to 25 C. Three nylon bags were buried in the fresh crop at two depths in each stave silo.

Stave silos were opened after 50 days and the silage was fed at a uniform rate for the following 10 weeks. Silages were sampled weekly and composited to form a biweekly sample for chemical analyses. The plastic containers were opened in duplicate for each silage treatment on days 1, 2, 3, 4, 12, and 122 post-ensiling. The nylon bags (three/silo) were recovered at approximately 25 and 60 days after the stave silos were opened.

Seventy-five crossbred steers were fed at the Hays Station in an 81-day growth trial (December 22, 1980 to March 12, 1981). The steers, native to Nebraska and averaging 508 lb, were randomly allotted by weight, breeding, and previous gains to the three silage rations (one pen of 15 steers per ration). Rations were the appropriate silage fed *ad libitum* plus 1.52 lb of supplemental ingredients that included 1.12 lb of soybean meal, .20 lb of premix , .10 lb of limestone, and .09 lb of ammonium sulfate. In the LSA-100 silage ration, .67 lb of grain sorghum replaced an equal amount of soybean meal. Rations were mixed and fed once daily and salt was available free-choice. Steers were implanted with 36 mg of Ralgro at the start of the trial.

Average initial and final steer weights were on a pay-weight to pay-weight basis. To allow for weight loss during the weighing day, the steers were weighed collectively by pens, at the start of each weighing day and then weighed individually. All individual steer weights were pencil shrunk 4.0% to obtain the adjusted individual steer weights.

To measure aerobic stability, approximately 60 lb of fresh silage was obtained from a 3-ft depth below the surface in the center of each stave silo on February 26, 1981. The silages then were transported immediately to Manhattan and stability determined as described on page 7 of this Progress Report.

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[5] Premix supplied 30,000 IU vitamin A, 300 mg monensin, 90 mg Tylan, 5 mg cobalt, 30 mg copper, 7 mg iodine, 150 mg iron, 100 mg manganese, and 272 mg zinc per steer daily.

Results

Chemical analyses of the three silages are shown in Table 4.1. All three silages were well preserved and had undergone normal fermentations. Compositions of control and Sila-bac silages were similar; but LSA-100 silage had a higher pH and more ammonia-nitrogen. The LSA-100 silage contained 12.0% crude protein (CP). The pre-ensiled crop was 7.19% CP. Adding 34.5 lb of LSA-100 per ton should have raised the CP to 12.62%, so 95.4% of the added nitrogen from LSA-100 was recovered in the silage.

Ensiling temperatures above initial temperatures are shown in Figure 4.1. The graph represents daily mean readings of four thermocouples per silo. Sila-bac silage had the fastest temperature rise, peaking in 5 days at 10 C above its initial temperature. LSA-100 silage showed a slow, steady increase in temperature over the 50-day ensiling period, reaching a maximum of 22 C above its initial temperature; while the control silage peaked at 15 C above its initial temperature in 12 days.

Steer performances are shown in Table 4.2. LSA-100 silage supported 7% faster gains than the control and 9% faster gains than Sila-bac silage ($P<.05$). This increase in gains by LSA-100 could have been due to the difference in ration CP level: control and Sila-bac, 10.1%, LSA-100, 12.9%. Feed intake was highest for LSA-100 silage; lowest for Sila-bac silage. Both LSA-100 and Sila-bac silages were utilized 3% more efficiently than was the control.

The dry matter lost during fermentation, storage, and feedout from the concrete staves was similar for the control and LSA-100 silages (16.9 and 17.5%, respectively) and lowest (14.0%) for Sila-bac (Table 4.3). In the stave silos, about 5% of the dry matter ensiled was discarded as non-feedable spoilage when the silos were opened. This surface loss was probably due to poor compaction and air penetration and not to the treatments.

Dry matter losses from the buried bags were less ($P<.05$) for Sila-bac and LSA-100 silages (11.0 and 10.9%, respectively) than for the control (13.4%). Both additives increased ($P<.05$) dry matter recovered in the 5-gallon containers, which was 5 to 6 percentage units over the control silage. These represent the lowest possible dry matter losses that could be expected in large farm-scale silos.

Shown in Table 4.4 are steer gains per ton of forage sorghum crop ensiled. These data combine feedlot performance (Table 4.2) and silage recovery from the concrete stave silos (Table 4.3). Compared with the control, Sila-bac sorghum silage produced 6.2 extra pounds and LSA-100 1.9 extra pounds of steer gain/ton of ensiled crop.

The control silage was less stable in air than were the additive silages (Table 4.5). It heated on day 3; Sila-bac and LSA-100 silages showed no signs of spoilage until day 7. When exposed to air, the control silage had lost 8.8% of its dry matter at first notice of temperature rise.

By the time both additive silages had heated and started to lose dry matter, the control had lost more than 16% of its dry matter. After 1 week of air exposure (i.e., silage surfaces or silage piles), the control would have lost 15% of its available dry matter, while the additive silages would have lost only 3%.

Table 4.1. Chemical analyses of control, Sila-bac, and LSA-100 forage sorghum silages[1]

Silage	Dry matter	pH	Crude protein	Crude fiber	Ether extract	Ash	Lactic acid	Acetic acid	Butyric acid*	NH_3-N**
	%		% of the DM							
Control	29.08	3.92	7.2	23.2	2.0	8.0	3.58	1.82	TR	3.39
Sila-bac	30.13	3.92	7.1	23.1	2.9	7.9	3.85	1.58	ND	4.46
LSA-100	30.53	4.05	12.0	22.4	3.0	7.9	3.52	1.88	TR	17.45

[1] Each value is the mean of five samples.

*ND means none detected; TR means traces detected.

** NH_3 is ammonia-nitrogen expressed as percent of total nitrogen.

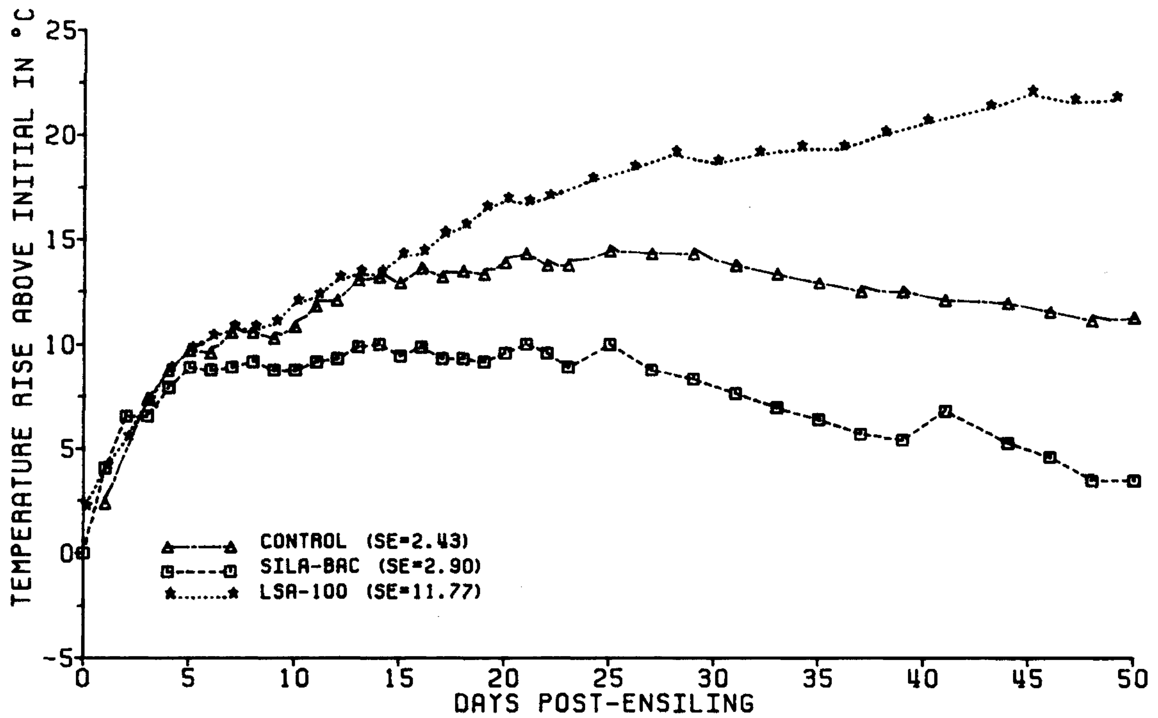

Figure 4 .l. Ensiling temperature (degrees above initial temperature) for the three forage sorghum silages. Initial temperatures were 15, 22, and 8 C for control, Sila-bac, and LSA-100 silages, respectively.

Table 4.2. Performance by steers fed the three forage sorghum silage rations

Item	Control	Sila-bac	LSA-100
No. of steers	15	15	15
Avg. initial wt., lb	512	505	506
Avg. final wt., lb	720	709	729
Avg. total gain, lb	208	203	222
Avg. daily gain, lb	2.56[a,b]	2.52[a]	2.75[b]
Avg. daily feed intake, lb[1]			
sorghum silage	13.00	12.28	13.58
soybean meal	1.12	1.12	.45
milo	- -	- -	.67
premix	.21	.21	.21
ammonium sulfate	.09	.09	.09
ground limestone	.10	.10	.10
total	14.52	13.80	15.10
Feed/lb of gain, lb[1]	5.67	5.48	5.49

[1]100% dry matter basis.

[a,b]Values with different superscripts differ significantly (P<.05).

Table 4.3. Forage sorghum silage fermentation, storage, and feedout losses from the concrete stave and experimental silos.

Silo and silage treatment	DM recovered Feedable	DM recovered non-feedable (spoilage)	DM lost during fermentation, storage, and feedout
	% of the DM put into the silo		
Concrete staves			
Control	78.05	5.03	16.92
Sila-bac	81.16	4.85	13.99
LSA-100	77.28	5.23	17.49
Nylon bags[1]			
Control	86.65	--	13.35
Sila-bac	88.97	--	11.03
LSA-100	89.11	--	10.89
5-gallon containers[2]			
Control	86.55[a]	--	13.45
Sila-bac	91.03[b]	--	8.97
LSA-100	92.08[b]	--	7.92

[1]Each value is the mean of six bags.

[2]Each value is the mean of two containers at 122 day post-ensiling.

[a,b]Values with different superscripts differ significantly (P<.05).

Table 4.4. Steer gain per ton of sorghum crop ensiled*

Item	Control	Sila-bac	LSA-100
Silage fed, lb/ton	1561	1623	1546
Silage/lb of gain, lb	18.90	18.27	18.30
Steer gain/ton of sorghum crop ensiled, lb	82.6	88.8	84.5

*Values are adjusted to same dry matter content for each silage, 30%.

Table 4.5. Changes in temperature and losses of dry matter during air exposure for the three forage sorghum silages.

Silage	Day of initial rise above ambient temperature*	Maximum temperature	Accumulated temperature above ambient, Days exposed to air: 3	5	9	13	Loss of DM, Days exposed to air: 3	5	9	13
		C	C				% of DM exposed to air			
Control	3	35.0	9.6	33.9	56.9	81.1	8.7[a]	13.4[a]	16.4[a]	21.7[a]
Sila-bac	7	35.6	**	**	14.1	70.5	<1.0[b]	<1.0[b]	6.6[b]	14.9[b]
LSA-100	7	40.0	**	**	18.3	97.5	<1.0[b]	<1.0[b]	3.9[b]	22.2[a]

*1.7 C rise or higher.

**No rise in temperature.

[a,b]Values in columns with different superscripts differ significantly (P<.05).